I. Epidemiology

A. Over 2 million poison exposures reported in 2003

B. 53% of these exposures were in children less than 6 years of age

C. 74% of all exposures were ingestions and 86% were unintentional

D. Poisoning: 4th leading cause of death in preschoolers
   3% of all fatalities were children less than 6 years of age

E. Adolescents with intentional/suicidal ingestions - consider polypharmacy

F. Poison Centers receive calls in reference to individuals less than 18 years of age
   in over 70% of cases, and greater than 70% of these cases can be managed in a
   non-health care facility

G. Most common pharmaceutical ingestions: 1) analgesics  2) cold preparations

H. and non-pharmaceutical ingestions:  1) cosmetics/personal care  2) cleaning substances

II. History

Should be brief and focused in unstable or comatose patient!

A. Known (or suspected) ingestion:
   a. what drug(s) taken?
   b. when?
   c. where?
   d. how much? and form ingested (always assume the worst case scenario)
   e. symptoms?
   f. home therapy

B. Unknown substance:
   a. have someone go home and bring in container if possible
   b. when was child last seen
   c. if unknown product, do they know it’s intended use
   d. medications in the home including visiting relatives

C. Increased incidence of ingestion if:
   a. acute onset
   b. history of ingestion / pica use
   c. household social dysfunction
   d. age 1 - 4 years, male
   e. multi-organ dysfunction
   f. altered mental status

III. Physical Examination
a. Vital signs
b. Neurologic status
c. Pupils
d. Odors
e. Skin

IV. Laboratories: (individualize)

a. Accucheck - certainly in all patients with altered mental status
b. Arterial Blood Gas with co-oximetry
c. 12 lead EKG
d. **Anion Gap**: \( \text{Na} - (\text{Cl} + \text{HCO}_3^-) \) (normal 8 - 12)

Increased Anion Gap: 
- \( C = \text{CO, CN} \)
- \( A = \text{AKA} \)
- \( T = \text{toluene} \)
- \( M = \text{methanol} \)
- \( U = \text{uremia} \)
- \( D = \text{DKA} \)
- \( P = \text{paraldehyde, phenformin} \)
- \( I = \text{iron, INH, ibuprofen, idiopathic} \)
- \( L = \text{lactic acidosis} \)
- \( E = \text{ethanol, ethylene glycol} \)
- \( S = \text{salicylates} \)

A normal anion gap **does not** rule out these toxins entirely!

e. **Osmolar Gap**: measured serum osmolarity - predicted \( (2 \times \text{Na} + \text{BUN} + \text{glucose} + \text{ETOH}) \)

\[ \begin{align*}
\text{normal osmol gap} &< 10 \text{ mOsm} \\
2.8 &\quad 18 &\quad 4.6
\end{align*} \]

: elevated with: ethanol, methanol, ethylene glycol, isopropyl alcohol

f. Complete blood count, Chemistries, LFTs, PT/PTT

g. Toxicology screen: 1) specific serum assay (quantitative) ie. ethanol, acetaminophen, salicylates, iron, digoxin, lead, CO, methemoglobin

2) immunoassay of urine for drugs of abuse (cocaine, opiates, barbiturates, amphetamines, and benzodiazepines)

3) comprehensive screens - these rarely aid in diagnosis or alter medical therapy

**Remember**: toxins analyzed by labs are not universal - know your lab’s capabilities
h. Radiographs: some substances are frequently radio-opaque:

- **C** = chloral hydrate
- **H** = heavy metals
- **I** = iodine, iron
- **P** = phenothiazines
- **S** = sustained release preparations (enteric coated tabs)

V. Initial Management

1) Airway (have lower threshold to protect secondary to the use of decontamination)
2) Breathing (O$_2$)
3) Circulation (IV access)
4) Disability / Dextrose / Decontamination / Drugs (narcan)
5) Exposure / Enhanced elimination
6) Antidotes

By far, **supportive care** is the most important aspect of management!

VI. Decontamination

1) remove clothing, flushing the skin and eyes when indicated

2) **Syrup of Ipecac**: induces vomiting, ? utility at home, has no place in the ER  
   Dosage: 10cc for infants, 15cc children, 30cc adolescents
   Contraindications: caustics, aliphatic hydrocarbons, seizures, altered mental status, agents that rapidly depress mentation (TCAs)

3) **Gastric Lavage**:  
   - use only if life-threatening ingestion within 1 hour of evaluation  
   - time consuming, efficacy not proven in the literature  
   Method: patient placed LLD, pass large OGT (24 - 36 Fr), lavage with 100 cc aliquots of NS to 1L or until clear  
   Contraindications: caustics, aliphatic hydrocarbons, GI bleed

4) **Activated Charcoal**: decreases absorption by adsorbing toxin >> removed by the gut  
   : interferes with enterohepatic circulation  
   : generally recommended within 1 hour of ingestion  
   Dose: 1 gm/kg (20gm minimum in toddlers and 100gm max in adolescents)  
   Contraindications / Absorption negligible:
   - **C** = caustics
   - **H** = heavy metals / hydrocarbons (aliphatics)
   - **A** = alcohols
   - **R** = rapid onset (camphor, cyanide)
   - **G** = GI bleed
   - **E** = ETT (unprotected airway)
5) **Catharsis**: prevent charcoal constipation

   - only with the 1st dose of charcoal (unproven value)
   - sorbitol most rapid acting: 70% soln., 1 gram/kg
   - Mg citrate: 4 cc/kg

6) **Whole Bowel Irrigation** (WBI)

   - use of a glycol balanced electrolyte solution such as Golytely
   - no change in net fluid balance
   - Indications: iron, sustained release ingestions, lithium (not bound by charcoal)
   - dose: 0.5 - 1.0 liter/hour

VII. **Enhanced Elimination**

1) **Multiple dose activated charcoal** (GI dialysis): ProlongeD QTC

   P = phenobarbital, phenytoin?
   D = dapsone
   Q = quinine
   T = theophylline
   C = carbamazepine

2) **Alkalization**: use of NaHCO₃ to enhance renal excretion

   a. unable to reabsorb weak acids (ie. salicylates) with a urinary ph > 7.0

   b. serum ph > 7.5 increases protein binding >> less free drug >> increase elimination

3) **Hemodialysis / Hemoperfusion**

   - indications: renal insufficiency and/or progressive deterioration despite conventional therapy

   - limitation: drugs with high volume of distribution (Vd)
     : unable to use hemodialysis if toxin highly protein bound

   - hemodialysis: phenobarbital, salicylates, alcohols, lithium
   - hemoperfusion: theophylline (highly protein bound)
VIII. Specific Poisonings

1) Acetaminophen

Toxicity: due to glutathione depletion in the liver and accumulation of metabolites which bind to hepatocytes >>> centrilobular necrosis

- toxic dose 140 mg/kg

Clinical: 4 stages:
1) Gastrointestinal (1/2 - 24 hrs.) - NV, abdominal pain
2) Latent (24 - 48 hrs.) - increasing LFTs, clinically improved
3) Hepatic (72 - 96 hrs.) - peak liver toxicity
4) Recovery vs. Morbidity (4 days - 2 weeks)

Diagnosis: Acetaminophen level at 4 hours post-ingestion or ASAP thereafter
- plot on Rumack-Matthew nomogram for likelihood of hepatic toxicity for acute, single ingestion only
- also check LFTs, Dstick

Therapy: a) Activated charcoal initially

b) if level toxic start NAC (N-acetylcysteine) = a glutathione substitute
   - prevent and treat hepatotoxicity
   - 140 mg/kg load NG/PO then 70 mg/kg for 17 doses
   - most efficacious if given w/ in 10 hrs. - may be given up to 48 hrs.
     from time of ingestion

   - if > 4 hours post-ingestion on presentation, check level and give initial dose of NAC if a toxic dose was taken (if it is possible to receive the level prior to 10 hours post-ingestion, you may elect to hold on giving the NAC)

2) Iron Poisoning

- 1/3 to 1/2 of all pediatric drug overdose deaths
- iron absorbed in the duodenum/jejunum in the ferrous state (Fe++) >>> bound to ferritin in the plasma as ferric (Fe+++)
  iron >>> transferrin >>> RE system

Toxicity: > 60 mg/kg of elemental iron at risk for systemic toxicity
- free iron leads to uncoupling of oxidation phosphorylation >>> acidosis
- increased capillary permeability, vasodilator >>> poor perfusion and shock

Clinical: 4 stages:
1) GI - diarrhea, NV, abdominal pain (0 - 6 hours)
2) latent (6 - 12 hours)
3) multi-organ failure, coagulopathy (12 - 24 hours)
4) late - gastric scarring / stenosis (4 - 6 weeks)

- signs of acidosis and shock may appear in stages 1 or 2 also

Diagnosis: a. 2 - 6 hour serum iron level
   b. TIBC inaccurate and unnecessary
c. WBC count > 15,000 and hyperglycemia (> 150 mg/dl) sensitive for elevated iron level but not specific
d. KUB positive for intact iron tablets following an acute ingestion (not liquid iron or iron contained in multivitamins)
e. A negative KUB does not rule out a significant ingestion

Therapy: ABCs, supportive care

1. if no systemic symptoms are present and the KUB is negative, hold on WBI and await on iron level

2. if no systemic symptoms but the KUB has a large number of tablets on KUB, start WBI and await on the level

3. if systemic signs are present at any time or the patient has an iron level > 500 mcg/dl, use WBI and start deferoxamine 10 - 15 mg/kg/hr IV

- watch for hypotension
- treatment endpoint is controversial

* Remember: charcoal does not bind to iron

3) Cyclic Antidepressants

: delayed gastric emptying, high Vd, toxic effects within 4 hours

Toxicity: toxic dose > 10 mg/kg, lethal dose > 30 mg/kg

1) anticholinergic effects

2) inhibit amine uptake (norepinephrine) >> tachycardia

3) $\text{Na}^+$ channel blockade >>> QRS prolongation ( > 100 msec )

Clinical: anticholinergic symptoms

CNS - anxiety to seizures

dysrhythmias - sinus tachycardia progressing to ventricular fibrillation

Diagnosis: serum drug levels are not of predictive value, check EKG, ABG

Therapy: ABCs, supportive

Decontamination: single dose charcoal, multiple dose charcoal?
Serum Alkalization: NaHCO3 1-2 mEq/kg (want ph 7.5 to 7.55)
- reverses the blockade on sodium cardiac channels
- some studies show that sodium itself reverses this blockade

Consider norepinephrine for hypotension since reuptake is blocked by TCAs
Seizure control - benzodiazepines

4) **Salicylates**
   Source: aspirin, Pepto-Bismol, oil of wintergreen
   - weak acid so forms concretions >>> delayed gastric absorption
   - Vd = 0.1 L/kg

Toxicity: stimulates respiratory center >>> respiratory alkalosis
   uncouples phosphorylation oxidation, dehydration >>> metabolic acidosis
   toxic dose = 150 mg/kg

Clinical: NV, dehydration, tachypnea, tinnitus, hyperthermia, lethargy, seizures, non-cardiogenic pulmonary edema

Diagnosis: Check salicylate level on arrival then 2 hours later and plot on nomogram
   - ferric chloride turns urine purple
   - Other: hypoglycemia, hypokalemia, hyper/hyponatremia,

Treatment: supportive, decontamination
   **Alkalization** with NaHCO3 to keep urine ph > 7.5
   - good UOP but do not use forced diuresis as pulmonary edema a complication
   - hemodialysis

5) **Alcohols**
   - rapid absorption, CNS depression, elevated osmol gap, hepatic ADH metabolism

   **Ethanol**: acidosis, hypothermia, hypoglycemia
   - supportive care, charcoal not efficacious (indicated if you suspect a coingestion)

   **Isopropyl** alcohol (rubbing alcohol): no acidosis, ketonuria, myocardial depression

   **Methanol**: acidosis secondary to formic acid, optic complications (temporary / permanent)
   - treat with folic acid, ethanol for levels > 20 mg/dl, hemodialysis if > 50 mg/dl

   **Ethylene glycol**: acidosis, ATN with Ca oxalate crystals in the urine
   Woods lamp the urine (fluorescence is present in antifreeze)

6) **Caustics**
**acids** = toilet bowl & drain cleaner, superficial coagulation necrosis

**alkalis** = drano, easyoff, liquid plummer, deep liquefaction necrosis

Clinical: dysphagia, drooling, burns

* lack of oral burns **does not** rule out esophageal injury

Management: no decontamination, tetanus prophylaxis, consultation

7) **Hydrocarbons**

   a) aspiration hazard (aliphatics): gas, lighter fluid, kerosene

   b) nontoxic: motor oil, suntan oil, mineral oil

   c) systemic toxicity:  
      - **C** - camphor
      - **H** - halogenated
      - **A** - aromatics
      - **M** - metals
      - **P** - pesticides

Clinical: aspiration = choking, coughing, tachypnea, rales, wheezing, fever

Management: decontaminate for group **C** above, **not** for the aliphatics

   - admit for symptoms and/or positive CXR

   - may discharge home if asymptomatic for 6 hours